also, U.S. Patent No. 6,134,506 at col. 3, lines 45-47, col. 9, lines 35-38, and col. 12, lines 3- 29; U.S. Patent No. 6,125,337 at col. 3, lines 45-47, col. 9, lines 35-38, and col. 18, lines 28-31; and U.S. Patent No. 6,078,976 at the Abstract, col. 9, lines 39-41, and col. 12, lines 3- 29. These U.S. Patents are included herewith as part of a Supplemental Information Disclosure Statement.

Furthermore, the reference to the term "an automatic work volume," as used in the Office Action, is taken out of the context of the claims, which recite an "automatic work volume calibration method for use with a haptic interface ... ." As with the term "work volume," "automatic" is used consistent with its ordinary meaning. Specifically, the term "automatic" is merely used to represent that the work volume is calibrated automatically.

With respect to the term "haptic interface," the application relates to a force reflecting haptic interface, which is described generally in the specification at, for example, page 1, lines 11-13, and page 1, line 25 to page 2, line 11. Haptic interfaces are notoriously well known in the art. See, for example, U.S. Patent No. 6,111,577 and U. S. Patent No. 6,219,589, which are included herewith as part of the Supplemental Information Disclosure Statement.

Elected claims 24-31 are drawn to methods and a system for automatic calibration of a work volume for use with a haptic interface. The Office Action specifically objects to the rotary element, because the rotary element fails to provide any haptic function. The rotary element is only a single part of the haptic interface and not the haptic interface itself. With respect to independent claims 25 and 30, the rotary element as claimed is an element utilized for calibrating the work volume of a haptic interface.

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of the objections to the specification and rejection of claims 24-31 under 37 CFR 1.71.

2. Claim 24 is rejected under 35 U.S.C. § 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between steps. Applicants respectfully traverse this rejection.

Applicants respectfully submit that the claim, read in view of the specification and the prior art, does not require the recitation of the additional steps listed in the Office Action. Specifically, the recited steps are not necessary or essential to enable one skilled in the art to practice the claimed method. Claim 24 as presently written is one of a number of methods

disclosed in the present application to which the Applicants are entitled, because no prior art has been cited that discloses all of the steps of the claimed method, i.e., "initializing a position of the haptic interface" and "geometrically centering a user reference point."

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection of claim 24 under 35 U.S.C. § 112, second paragraph.

3. Claims 24-31 are rejected under 35 U.S.C. § 103(a), as being unpatentable over U.S. Patent No. 5,053,976 to Nose et al. ("Nose") in view of U.S. Patent No. 4,530,155 to Burkhardt et al. ("Burkhardt") or U.S. Patent No. 4,978,846 to Buote ("Buote"). Applicants respectfully traverse this rejection.

The invention, as claimed in independent claims 24, 25, and 30, relates to methods and a system for the automatic calibration of a work volume of a haptic interface. The haptic interface provides an interface between a user and a computer. Specifically, the interface provides tactile sensory feedback to a user and locates the position of a user within a volume of space. Claims 24 and 25 are directed to methods of automatically calibrating the haptic interface within that volume of space. Claim 30 is directed to a system, i.e., a combination of components, that are used to automatically calibrate the volume of space.

Previously, the work volume of a haptic interface may have been calibrated by manually holding the device in a predetermined calibration position and directing the computer to initialize and measure the device's position. Additionally, many haptic interfaces were calibrated by requiring a user to manually move the device to its axes limit stops and resetting the unit. The methods and system of the present invention eliminate the need to perform those types of operations. Generally, the present invention calibrates the work volume of the haptic interface by initializing a position of the haptic interface and tracking the angular orientation of a rotary element.

More specifically, Nose discloses a method of teaching a robot, such as an arc welding robot, to calculate its present position and then determine a moving vector from its present position to a next position. See col. 2, lines 36-46. Nose is specifically limited to determining a present position of a robot tool, i.e., an end effector, and calculating/determining the geometric path required to arrive at a next position. Additionally, a haptic interface is not analogous to a

robot. As discussed above, a haptic interface provides a sensory interface between a user and a computer model. A robot performs work along a geometric path. Nose does not in any way relate to a haptic interface. Further, nowhere in Nose is a method or system for calibrating a work volume disclosed, regardless of whether for a haptic interface or not.

As stated in the Office Action Summary, Burkhardt discloses a method for reproducing a reference position in an incremental measuring device. Further, Burkhardt discloses a calibration process for determining the reference position of a first object independent of a second object movable relative thereto, where the measurement of the object has been interrupted. The object whose reference position is sought is decoupled from the measuring device. See col. 2, lines 11-38 of Burkhardt. Burkhardt fails to disclose a haptic interface or methods or systems for calibrating the work volume thereof.

Lastly, Buote discloses an apparatus for measuring angular position and a system for automatically calibrating a potentiometer controlled angular position control device. See col. 1, lines 6-10, of Buote. The apparatus includes a rotatable mechanism and a potentiometer coupled to the rotatable mechanism. The potentiometer is adapted to produce an output signal indicative of the angular position of the rotatable mechanism. See col. 2, lines 17-22. Buote further discloses a robot 11 mounted on a turntable 12, the angular positions of which are tracked by the disclosed apparatus. See generally col. 3, line 50, to col. 4, line 65. Buote discloses a system for calibrating the angular position of a robot; however, Buote fails to disclose methods or systems for automatically calibrating a work volume. Buote also fails to disclose any system as applied to a haptic interface.

Neither Nose nor Burhardt nor Buote, alone or in combination, teach or suggest methods or systems for automatically calibrating the work volume of a haptic interface. Nose discloses methods of teaching a robot to determine its present position and next move; however, Nose fails to disclose anything with respect to calibrating a work volume or a haptic interface. Burkhardt fails to cure the deficiencies of Nose. First, Burhardt is related to measuring devices and discloses no application to haptic interfaces. Second, Burkhardt discloses reproducing a reference position, but contains no disclosure of a method or system of calibrating a work volume. Buote also fails to cure the deficiencies of Nose. Specifically, Buote is concerned with

the angular position of a rotary mechanism, but fails to disclose any application to a haptic interface or a method or system for automatically calibrating a work volume. Therefore, Applicants respectfully submit that neither Nose nor Burhardt nor Buote is particularly relevant or applicable to the claimed invention.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection of claims 24-31 under 35 U.S.C. § 103(a), as being unpatentable over Nose in view of Burkhardt or Buote.

CONCLUSION

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of all rejections and objections and allowance of claims 24-31 in due course. If, in the Examiner's opinion, a telephonic interview would expedite the favorable prosecution of the present application, the undersigned attorney would welcome the opportunity to discuss any outstanding issues.

Respectfully submitted,

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